CLAIMS

What is claimed is:

1	1.	A method for determining one or more fine-tuned estimates of delay value associated
2		with a received signal, the method comprising the computer-implemented steps of:
3		determining a range of delay values of interest associated with the received signal;
4		interpolating fine-grained values for I and Q correlation integrals by using a subset of
5		coarse-grained calculations of I and Q correlation integrals; and
6		determining the one or more fine-tuned estimates of delay value based on the fine-
7		grained values of I and Q correlation integrals.
1	2.	The method of Claim 1, wherein determining a range of delay values of interest
2		further comprises the steps of:
3		determining one or more initial estimates of the delay value;
4		selecting one of the one or more initial estimates of delay value to be a selected initial
5		estimate of delay value; and
6		selecting a range of delay values in the neighborhood of the selected initial estimate
7		of delay value to be the range of delay values of interest.
1	3.	The method of Claim 2, wherein selecting a range of delay values in the
2		neighborhood of the selected initial estimate of delay value to be the range of delay
3		values of interest is a function of the selected initial estimate of delay value and a pre-
4		selected confidence level.

1	4.	The method of Claim 1, wherein the subset of coarse-grained calculations of I and Q
2		correlation integrals is based on:
3		a pre-selected desired accuracy; and
4		a type of filter that was used to filter the received signal.
1	5.	The method of Claim 2, wherein determining the one or more initial estimates of the
2		delay value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of delay values for a sampled
5		data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of delay values; and
8		selecting a delay value that corresponds to a highest magnitude value corresponding
9		to the coarse-grained calculations of I and Q correlation integrals as the one or
10		more initial estimates of delay value.
1	6.	The method of Claim 2, wherein determining the one or more initial estimates of
2		delay value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of delay values for a sampled
5		data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of delay values; and

8		selecting one or more delay values that correspond to magnitude values that are above
9		a pre-selected threshold magnitude value as the one or more initial estimates
10		of delay value.
1	7.	The method of Claim 2, wherein determining the one or more initial estimates of the
2		delay value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of delay values for a sampled
5		data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of delay values;
8		determining a highest magnitude value corresponding to the coarse-grained
9		calculations of I and Q correlation integrals; and
10		selecting one or more delay values that correspond to magnitude values that are
11		within a pre-selected magnitude range around the highest magnitude value as
12		the one or more initial estimates of delay value.
1	8.	The method of Claim 5, wherein the hypothesized range of delay values is based on:
2		an approximate time when a receiver received the received signal;
3		a time uncertainty quantity that is associated with the approximate time;
4		an approximate position of the receiver; and
5		an position uncertainty quantity that is associated with the approximate position of
6		the receiver.

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2		correlation integrals is based on a bandlimited interpolation technique.
1 2	10.	The method of Claim 1, wherein the received signal is associated with a global positioning satellite vehicle.
1 2	11.	The method of Claim 1, wherein determining the one or more fine-tuned estimates delay value based on the fine-grained values of I and Q correlation integrals
3		comprises the steps of: calculating magnitude values corresponding to the fine-grained values of I and Q
5		correlation integrals over the range of delay values of interest; and
6		selecting one or more delay values that corresponds to a highest magnitude value
7		corresponding to the fine-grained values of I and Q correlation integrals as the
8		one or more fine-tuned estimates delay value.
1	12.	The method of Claim 1, wherein determining one or more fine-tuned estimates delay
2		value based on the fine-grained values of I and Q correlation integrals comprises the
3		steps of:
4		calculating magnitude values corresponding to the fine-grained values of I and Q
5		correlation integrals over the range of delay values of interest; and
6		selecting one or more delay values that correspond to magnitude values that are above
7		a pre-selected threshold magnitude value as the one or more fine-tuned
8		estimates of delay value

The method of Claim 1, wherein interpolating fine-grained values for I and Q

1	13.	The method of Claim 1, wherein determining one or more fine-tuned estimates delay
2		value based on the fine-grained values of I and Q correlation integrals comprises the
3		steps of:
4		calculating magnitude values corresponding to the fine-grained values of I and Q
5		correlation integrals over the range of delay values of interest;
6		determining a highest magnitude value corresponding to the fine-grained values of I
7		and Q correlation integrals; and
8		selecting one or more delay values that corresponds to magnitude values that are
9		within a pre-selected magnitude range around the highest magnitude value as
10		the one or more fine-tuned estimates of delay value.
1	14.	A method for determining one or more fine-tuned estimates of delay value associated
2		with a received signal, the method comprising the computer-implemented steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of delay values for a sampled
5		data that is associated with the received signal;
6		calculating a magnitude of the coarse-grained calculations of I and Q correlation
7		integrals over the hypothesized range of delay values; and
8		selecting a delay value from the hypothesized range of delay values that correspond to
9		a highest magnitude value that corresponds to the coarse-grained calculations
10		of I and Q correlation integrals as an initial estimate of delay value;
11		selecting a range of delay values in the neighborhood of the initial estimate of delay
12		value to be a range of delay values of interest;

13		interpolating fine-grained values for I and Q correlation integrals by using a subset of
14		coarse-grained calculations of I and Q correlation integrals;
15		calculating magnitude values corresponding to the fine-grained values of I and Q
16		correlation integrals over the range of delay values of interest; and
17		selecting one or more delay values that corresponds to a highest magnitude value
18		corresponding to the fine-grained values of I and Q correlation integrals as the
19		one or more fine-tuned estimates delay value.
1	15.	A method for determining one or more fine-tuned estimates of delay value associated
2		with a received signal, the method comprising the computer-implemented steps of:
3		determining an initial range of delay values of interest associated with the received
4		signal;
5		performing, if not already performed, a coarse-grained calculation of I and Q
6		correlation integrals over the initial range of delay values for a sampled data
7		that is associated with the received signal;
8		calculating a magnitude of the coarse-grained calculations of I and Q correlation
9		integrals over the hypothesized range of delay values; and
10		selecting a delay value from the hypothesized range of delay values that correspond to
11		a highest magnitude value that corresponds to the coarse-grained calculations
12		of I and Q correlation integrals as an initial estimate of delay value;
13		selecting a range of delay values in the neighborhood of the initial estimate of delay
14		value to be a range of delay values of interest;
15		generating a parametric template that represents I and Q correlation integrals
16		associated with the received signal; and

17		performing a linear regression on the range of delay values of interest to produce a
18		delay error function that is based on the range of delay values of interest; and
19		selecting from the range of delay values of interest one or more delay values that
20		minimize the delay error function as the fine-tuned estimates of delay value.
1	16.	The method of Claim 15, wherein the step of selecting from the range of delay values
2		of interest one or more delay values that minimize the delay error function comprises
3		the steps of:
4		from the range of delay values of interest, selecting a target delay value that produces
5		a minimum value of the delay error function; and
6		from the range of delay values of interest, selecting a range of delay values around the
7		target delay value as the one or more fine-tuned estimates of delay value.
	1.5	The state of the state of calcuting from the range of delay values
1	17.	The method of Claim 15, wherein the step of selecting from the range of delay values
2		of interest one or more delay values that minimize the delay error function comprises
3		the steps of:
4		selecting from the range of delay values of interest one or more delay values for
,5		which the delay error function is below a pre-selected threshold value of the
6		delay error function as the one or more fine-tuned estimates delay value.
1	18.	A method for determining one or more fine-tuned estimates of carrier frequency value
2		associated with a received signal, the method comprising the computer-implemented
3		steps of:
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4		determining a range of carrier frequency values of interest associated with the
5		received signal;
6		interpolating fine-grained values for I and Q correlation integrals by using a subset of
7		coarse-grained calculations of I and Q correlation integrals; and
8		determining the one or more fine-tuned estimates of carrier frequency value based on
9		the fine-grained values of I and Q correlation integrals.
1	19.	The method of Claim 18, wherein determining a range of carrier frequency values of
2		interest further comprises the steps of:
3		determining one or more initial estimates of carrier frequency value;
4		selecting one of the one or more initial estimates of carrier frequency value to be a
5		selected initial estimate of carrier frequency value; and
6		selecting a range of carrier frequency values in the neighborhood of the selected
7		initial estimate of carrier frequency value to be the range of carrier frequency
8		values of interest.
1	20.	The method of Claim 18, wherein the subset of coarse-grained calculations of I and Q
2		correlation integrals is based on:
3		duration of the I and Q correlation integral;
4		a pre-selected confidence level; and
5		a type of filter that was used to filter the received signal.

1	21.	The method of Claim 19, wherein determining the one or more initial estimates of
2		carrier frequency value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of carrier frequency values for
5		a sampled data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of carrier frequency
8		values; and
9		selecting a carrier frequency value that corresponds to a highest magnitude value
10		corresponding to the coarse-grained calculations of I and Q correlation
11		integrals as the one or more initial estimates of carrier frequency value.
1	22.	The method of Claim 19, wherein determining the one or more initial estimates of
2		carrier frequency value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of carrier frequency values for
5		a sampled data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of carrier frequency
8		values; and
9		selecting one or more carrier frequency values that correspond to magnitude values
10	,	that are above a pre-selected threshold magnitude value as the one or more
11		initial estimates of carrier frequency value.

1	23.	The method of Claim 19, wherein determining the one or more initial estimates of
2		carrier frequency value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of carrier frequency values for
5		a sampled data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of carrier frequency
8		values;
9		determining a highest magnitude value corresponding to the coarse-grained
10		calculations of I and Q correlation integrals; and
11		selecting one or more carrier frequency values that correspond to magnitude values
12		that are within a pre-selected magnitude range around the highest magnitude
13		value as the one or more initial estimates of carrier frequency value.
1	24.	The method of Claim 18, wherein the received signal is associated with a global
2		positioning satellite vehicle.
1	25.	The method of Claim 18, wherein determining the one or more fine-tuned estimates
2		of carrier frequency value based on the fine-grained values of I and Q correlation
3		integrals comprises the steps of:
4		calculating magnitude values corresponding to the fine-grained values of I and Q
5		correlation integrals over the range of carrier frequency values of interest; and

6		selecting one or more carrier frequency value that correspond to a highest magnitude
7		value corresponding to the fine-grained values of I and Q correlation integrals
8		as the one or more fine-tuned estimates carrier frequency value.
1	26.	The method of Claim 18, wherein determining one or more fine-tuned estimates of
2		carrier frequency value based on the fine-grained values of I and Q correlation
3		integrals comprises the steps of:
4		calculating magnitude values corresponding to the fine-grained values of I and Q
5		correlation integrals over the range of carrier frequency values of interest; and
6		selecting one or more carrier frequency values that correspond to magnitude values
7		that are above a pre-selected threshold magnitude value as the one or more
8		fine-tuned estimates carrier frequency value, respectively.
1	27.	The method of Claim 18, wherein determining one or more fine-tuned estimates of
2		carrier frequency value based on the fine-grained values of I and Q correlation
3		integrals comprises the steps of:
4		calculating magnitude values corresponding to the fine-grained values of I and Q
5		correlation integrals over the range of carrier frequency values of interest;
6		determining a highest magnitude value corresponding to the fine-grained values of I
7		and Q correlation integrals; and
8		selecting one or more carrier frequency values that correspond to magnitude values
9		that are within a pre-selected magnitude range around the highest magnitude
10		value as the one or more fine-tuned estimates carrier frequency value.

l	28.	A method for determining one of more fine-tuned estimates of earlier frequency value
2		associated with a received signal, the method comprising the computer-implemented
3		steps of:
4		performing, if not already performed, a coarse-grained calculation of I and Q
5		correlation integrals over a hypothesized range of carrier frequency values for
6		a sampled data that is associated with the received signal;
7		calculating a magnitude of the coarse-grained calculations of I and Q correlation
8		integrals over the hypothesized range of carrier frequency value; and
9		selecting a carrier frequency value from the hypothesized range of carrier frequency
10		value that correspond to a highest magnitude value that corresponds to the
11		coarse-grained calculations of I and Q correlation integrals as an initial
12		estimate of carrier frequency value;
13		selecting a range of carrier frequency values in the neighborhood of the initial
14		estimate of carrier frequency value to be a range of carrier frequency values of
15		interest;
16		interpolating fine-grained values for I and Q correlation integrals by using a subset of
17		coarse-grained calculations of I and Q correlation integrals;
18		calculating magnitude values corresponding to the fine-grained values of I and Q
19		correlation integrals over the range of carrier frequency values of interest; and
20		selecting one or more carrier frequency value that corresponds to a highest magnitude
21		value corresponding to the fine-grained values of I and Q correlation integrals
22		as the one or more fine-tuned estimates carrier frequency value.

1	29.	A method for determining one or more fine-tuned estimates of carrier frequency value
2		associated with a received signal, the method comprising the computer-implemented
3		steps of:
4		determining an initial range of carrier frequency values of interest associated with the
5		received signal;
6		performing, if not already performed, a coarse-grained calculation of I and Q
7		correlation integrals over the initial range of carrier frequency values for a
8		sampled data that is associated with the received signal;
9		calculating a magnitude of the coarse-grained calculations of I and Q correlation
10		integrals over the hypothesized range of carrier frequency values; and
11		selecting a carrier frequency value from the hypothesized range of carrier frequency
12		values that correspond to a highest magnitude value that corresponds to the
13		coarse-grained calculations of I and Q correlation integrals as an initial
14		estimate of carrier frequency value;
15		selecting a range of carrier frequency values in the neighborhood of the initial
16		estimate of carrier frequency value to be a range of carrier frequency values of
17		interest;
18		generating a parametric template that represents I and Q correlation integrals
19		associated with the received signal;
20		performing a linear regression on the range of carrier frequency values of interest to
21		produce a carrier frequency error function that is based on the range of carrier
22		frequency values of interest: and

23		selecting from the range of carrier frequency values of interest one of more carrier
24		frequency values that minimize the carrier frequency error function as the
25		fine-tuned estimates of carrier frequency value.
1	30.	The method of Claim 29, wherein the step of selecting from the range of carrier
2		frequency values of interest one or more carrier frequency values that minimize the
3		carrier frequency error function comprises the steps of:
4		from the range of carrier frequency values of interest, selecting a target carrier
5		frequency value that produces a minimum value of the carrier frequency error
6		function; and
7		from the range of carrier frequency values of interest, selecting a range of carrier
8		frequency values around the target carrier frequency value as the one or more
9		fine-tuned estimates of carrier frequency value.
1	31.	The method of Claim 29, wherein the step of selecting from the range of carrier
2		frequency values of interest one or more carrier frequency values that minimize the
3-		carrier frequency error function comprises the steps of:
4		selecting from the range of carrier frequency values of interest one or more carrier
5		frequency values for which the carrier frequency error function is below a pre-
6		selected threshold value of the carrier frequency error function as the one or
7		more fine-tuned estimates carrier frequency value.

1	32.	A method for determining one or more fine-tuned estimates of parameter values
2		associated with a received signal, the method comprising the computer-implemented
3		steps of:
4		determining a range of parameter values of interest associated with the received
5		signal;
6		interpolating fine-grained values for I and Q correlation integrals by using a subset of
7		coarse-grained calculations of I and Q correlation integrals; and
8		determining the one or more fine-tuned estimates of parameter value based on the
9		fine-grained values of I and Q correlation integrals.
1	33.	The method of Claim 32, wherein parameter values comprise a vector including all or
2		a subset of multipath characteristics, signal power, delay, and carrier frequency.
1	34.	The method of Claim 32, wherein determining a range of parameter values of interest
2		further comprises the steps of:
3		determining one or more initial estimates of the parameter value;
4		selecting one of the one or more initial estimates of parameter value to be a selected
5		initial estimate of parameter value; and
6		selecting a range of parameter values in the neighborhood of the selected initial
7		estimate of parameter value to be the range of parameter values of interest.
1	35.	The method of Claim 34, wherein selecting a range of parameter values in the
2		neighborhood of the selected initial estimate of parameter value to be the range of

3		parameter values of interest is a function of the selected initial estimate of parameter
4		value and a pre-selected confidence level.
1	36.	The method of Claim 34, wherein determining the one or more initial estimates of the
2		parameter value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of parameter values for a
5		sampled data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of parameter values;
8		and
9		selecting a parameter value that corresponds to a highest magnitude value
10		corresponding to the coarse-grained calculations of I and Q correlation
11		integrals as the one or more initial estimates of parameter value.
1	37.	The method of Claim 34, wherein determining the one or more initial estimates of
2		parameter value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of parameter values for a
5		sampled data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of parameter values;
8		and

9		selecting one or more parameter values that correspond to magnitude values that are
10		above a pre-selected threshold magnitude value as the one or more initial
11		estimates of parameter value.
1	38.	The method of Claim 34, wherein determining the one or more initial estimates of the
2		parameter value further comprises the steps of:
3		performing, if not already performed, a coarse-grained calculation of I and Q
4		correlation integrals over a hypothesized range of parameter values for a
5		sampled data that is associated with the received signal;
6		calculating magnitude values corresponding to the coarse-grained calculations of I
7		and Q correlation integrals over the hypothesized range of parameter values;
8		determining a highest magnitude value corresponding to the coarse-grained
9		calculations of I and Q correlation integrals; and
10		selecting one or more parameter values that correspond to magnitude values that are
11		within a pre-selected magnitude range around the highest magnitude value as
12		the one or more initial estimates of parameter value.
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1	39.	A method for determining one or more fine-tuned estimates of parameter value
2		associated with a received signal, the method comprising the computer-implemented
3		steps of:
4		determining an initial range of parameter values of interest associated with the
5		received signal;

6		performing, if not already performed, a coarse-grained calculation of I and Q
7		correlation integrals over the initial range of parameter values for a sampled
8		data that is associated with the received signal;
9		calculating a magnitude of the coarse-grained calculations of I and Q correlation
10		integrals over the hypothesized range of parameter values; and
11		selecting a parameter value from the hypothesized range of parameter values that
12		correspond to a highest magnitude value that corresponds to the coarse-
13		grained calculations of I and Q correlation integrals as an initial estimate of
14		parameter value;
15		selecting a range of parameter values in the neighborhood of the initial estimate of
16		parameter value to be a range of parameter values of interest;
17		generating a parametric template that represents I and Q correlation integrals
18		associated with the received signal; and
19		performing a linear regression on the range of parameter values of interest to produce
20		a parameter error function that is based on the range of parameter values of
21		interest; and
22		selecting from the range of parameter values of interest one or more parameter values
23		that minimize the parameter error function as the fine-tuned estimates of
24		parameter value.
1	40.	The method of Claim 39, wherein the step of selecting from the range of parameter
2		values of interest one or more parameter values that minimize the parameter error
3		function comprises the steps of:

4		from the range of parameter values of interest, selecting a target parameter value that
5		produces a minimum value of the parameter error function; and
6		from the range of parameter values of interest, selecting a range of parameter values
7		around the target parameter value as the one or more fine-tuned estimates of
8		parameter value.
1	41.	The method of Claim 39, wherein the step of selecting from the range of parameter
2		values of interest one or more parameter values that minimize the parameter error
3		function comprises the steps of:
4		selecting from the range of parameter values of interest one or more parameter
5		values for which the parameter error function is below a pre-selected
6		threshold value of the parameter error function as the one or more fine-tuned
7		estimates parameter value.